National Air Toxic Assessment (NATA) - The Initial National Scale Assessment

Air Toxics Exposure Assessment Workshop

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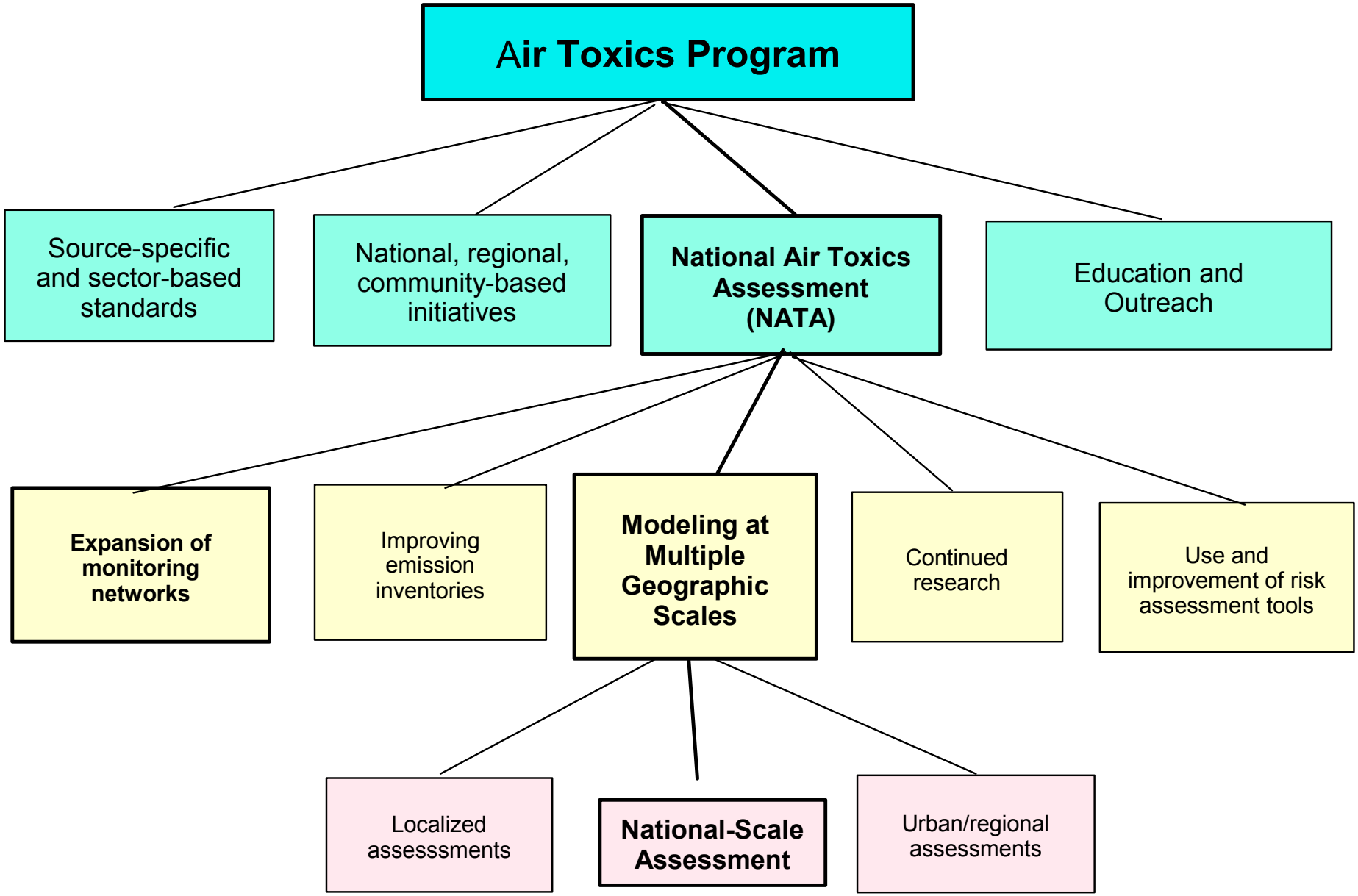

Air Toxics Program
Source-specific and sector-based standards
National, regional, community-based initiatives
National Air Toxics Assessment (NATA)
Education and Outreach
Expansion of monitoring networks
Improving emission inventories
Modeling at Multiple Geographic Scales
Continued research
Use and improvement of risk assessment tools
Localized assesssments
National-Scale Assessment
Urban/regional assessments

NATA Activities are…

- ...a number of technical support activities designed to provide all parts of EPA's Air Toxics Program with the following quantitative, policy-relevant, and consistent information:
  - Emissions inventories
  - **Monitoring** network
  - Air quality, exposure, and risk **modeling**
  - Research on effects and assessment tools

1996 National Scale Assessment – Recent History

- Initial draft of 1996 assessment: Summer 2000
- S/L/T preview of entire assessment: Fall 2000
- Detailed technical document prepared for SAB review: January 2001
- SAB Review: March 2001
- SAB Report: December 2001
- Update Assessment based on SAB “short-term” recommendations: January 2002
- Previewed by S/L/T: January - March 2002
- Website opened to public: May 31, 2002

Goals of the Initial National-Scale Assessment

- Tool for EPA and States/Locals/tribes
- Identify air toxics of greatest concern
- Characterize contributions of different emission sources to exposure and risk
- Prioritize collection of new data
- Provide a baseline (with ambient data) to track trends and measure progress against goals
- By itself, the assessment is **NOT** being used as the basis for specific regulatory decisions

Limitations of the Initial National-Scale Assessment

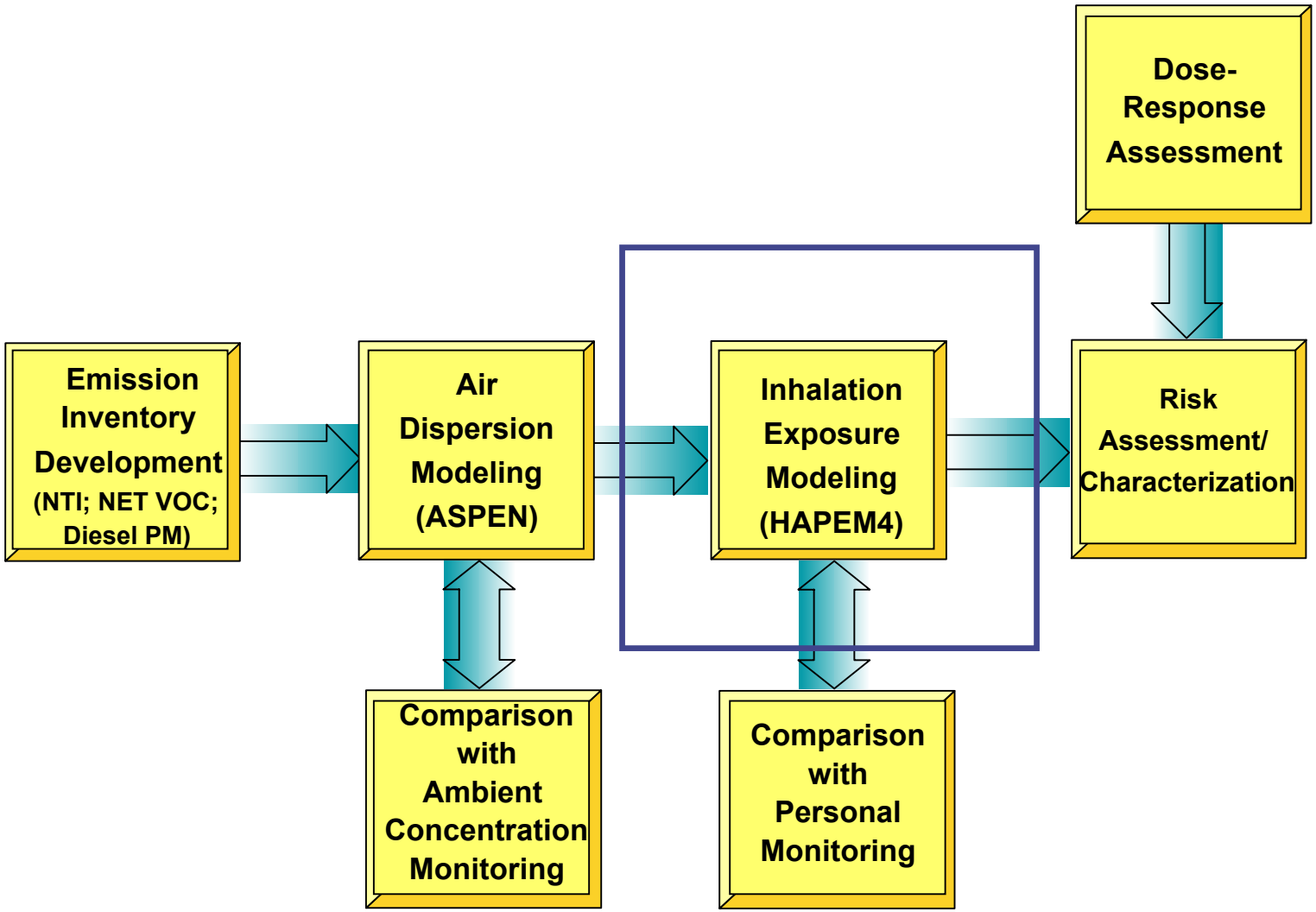
- Inhalation exposure **only**
- Chronic exposures **only**
- 1996 emissions data
- Sources of indoor origin **excluded**
- 50-km range
- Focuses on average/median exposures, not individual extremes
- Census tract-level calculations; county-level and higher presentations
- 32 urban HAPs & diesel PM

Pollutants* included in the Initial National-Scale Assessment

- acetaldehyde
- acrolein
- acrylonitrile
- arsenic compounds
- benzene
- beryllium compounds
- 1,3-butadiene
- cadmium compounds
- carbon tetrachloride
- chloroform
- chromium compounds
- coke oven emissions
- 1,2-dibromoethane (ethylene dibromide)
- 1,2-dichloropropane (propylene dichloride)
- 1,3-dichloropropene
- ethylene dichloride (1,2-dichloroethane)
- ethylene oxide
- formaldehyde
- hexachlorobenzene
- hydrazine
- lead compounds
- manganese compounds
- mercury compounds
- methylene chloride (dichloromethane)
- nickel compounds
- polychlorinated biphenyls (PCBs)
- polycyclic organic matter (POM)
- quinoline
- 1,1,2,2-tetrachloroethane
- tetrachloroethylene (perchloroethylene)
- trichloroethylene
- vinyl chloride
- diesel particulate matter

*List based on the 33 urban HAPs. Dioxin, also an urban HAP, was not included because of inventory inconsistencies.

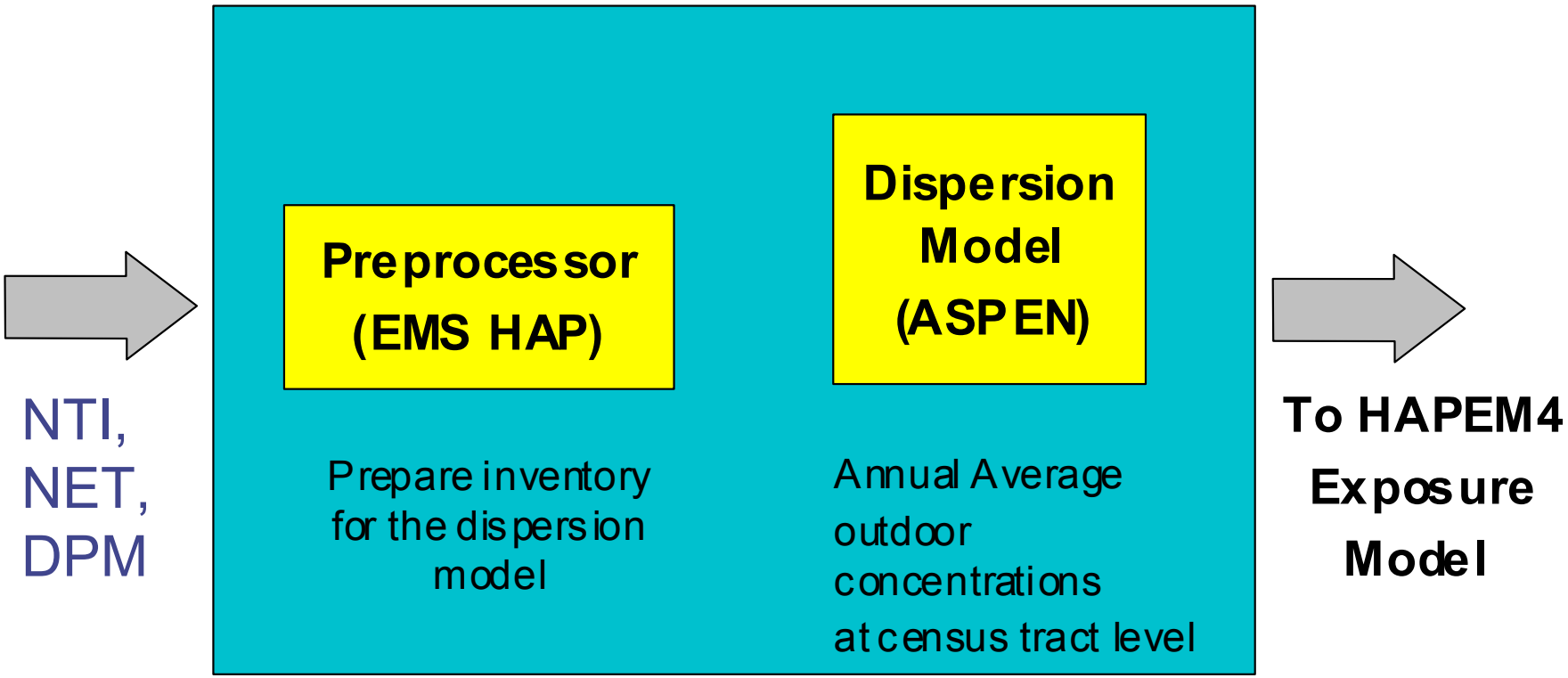
Components of the Initial National-Scale Assessment



NATA Emission Inventory

- Entire Assessment is only as good as the inventory used in modeling
  - 1996 National Toxics Inventory (NTI)
    - 32 Urban HAPs, includes mobile and stationary sources
    - Primary source of data from States/Locals
    - Includes model parameters for many stationary sources
  - 1996 VOC in National Emissions Trends Inventory
    - Used for secondarily formed components of formaldehyde and acetaldehyde
  - Diesel PM - 1996 Heavy Duty Diesel Rule Inventory

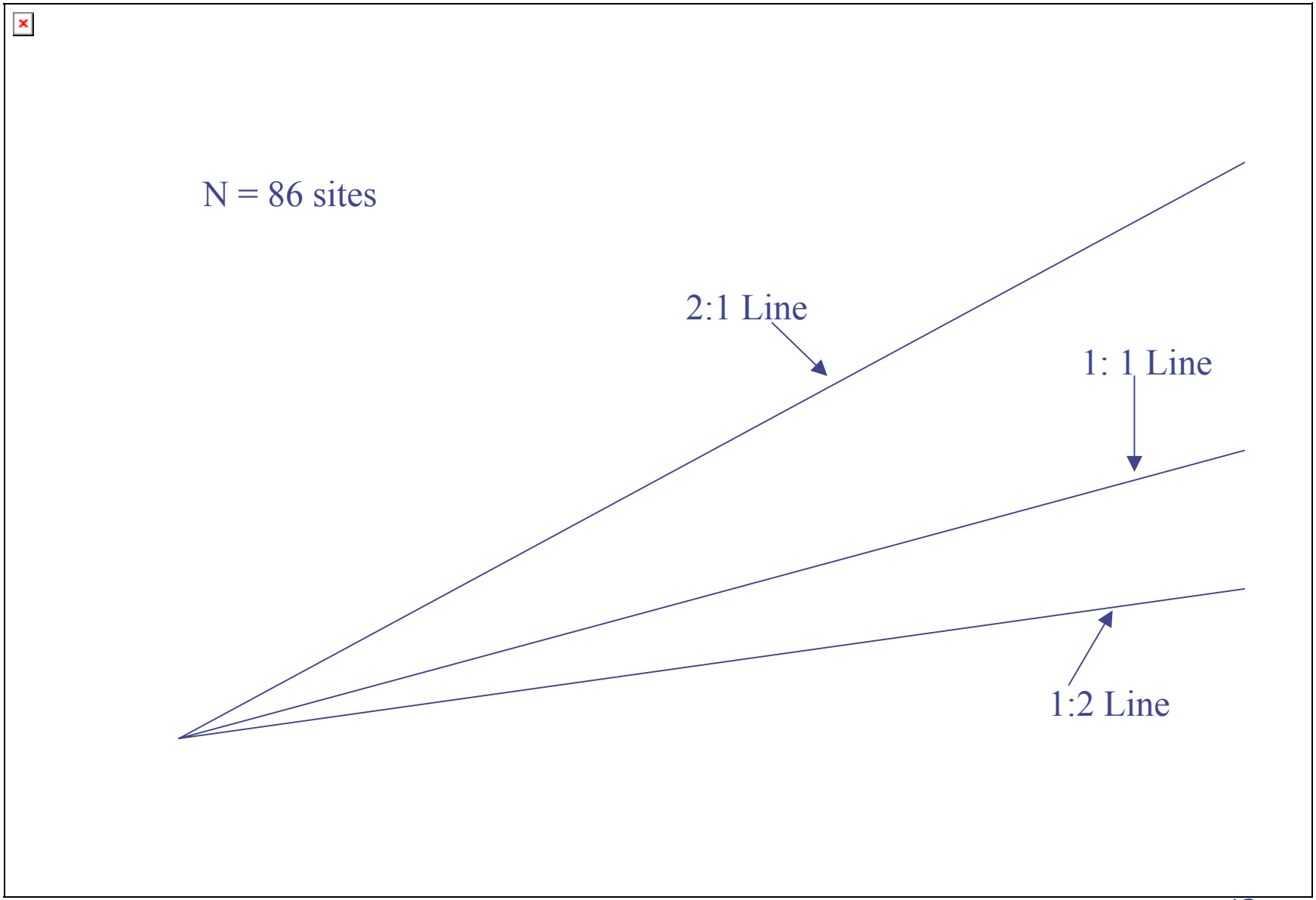
NATA - Emission Preprocessor



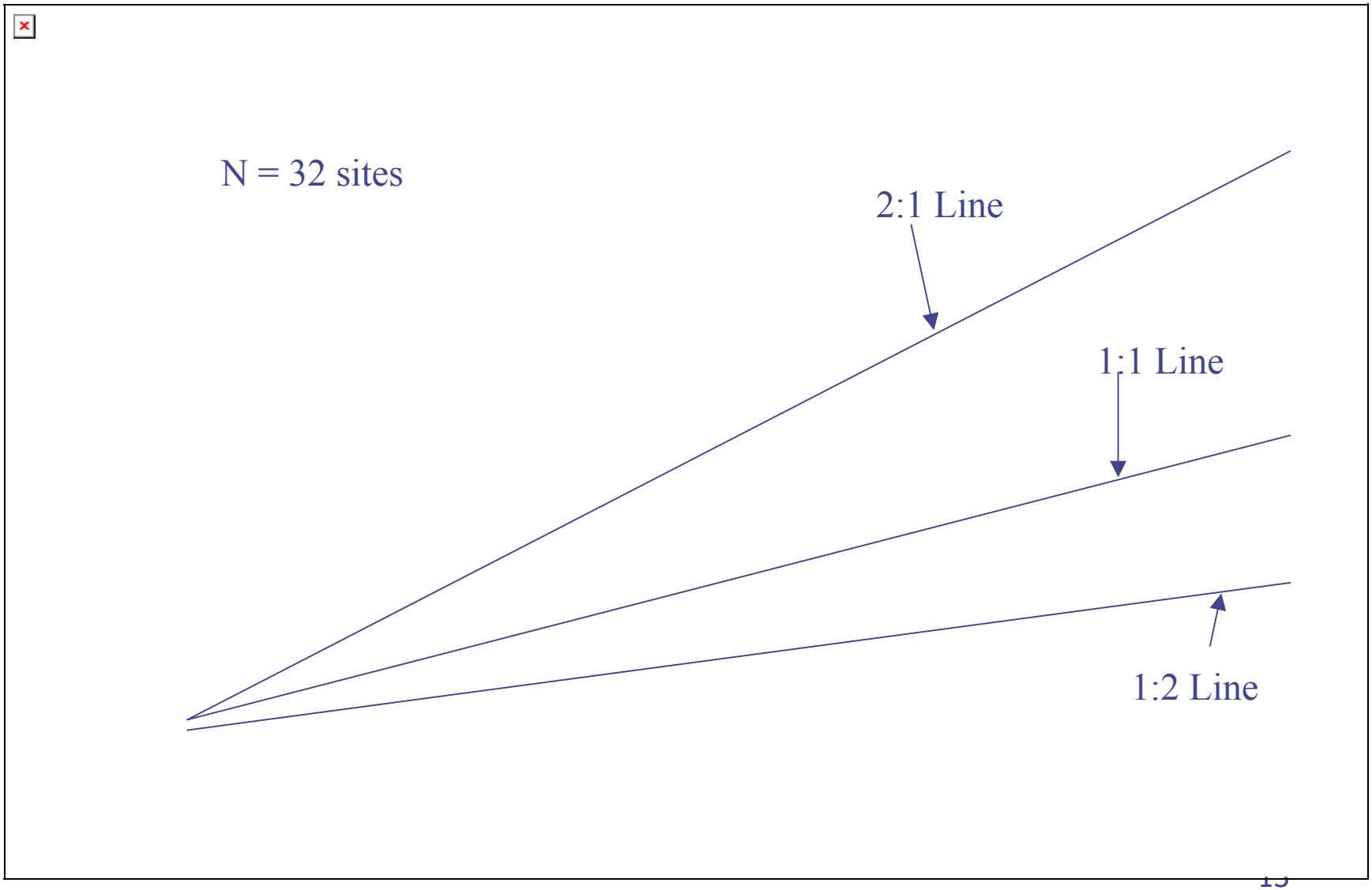
NATA - Ambient Concentrations Model

- Utilized the ASPEN Model
- Gaussian Model - ISCLT2
- Modeled 50 km radius around all sources
- Employed a fixed nationwide background concentration for 13 HAPs
- Predicted annual average ambient concentrations at each census tract for 4 source sectors (+ background)
- Domain included 48 contiguous states, DC, Virgin Islands and Puerto Rico
- Limited model to monitor comparisons performed between ASPEN and monitoring data

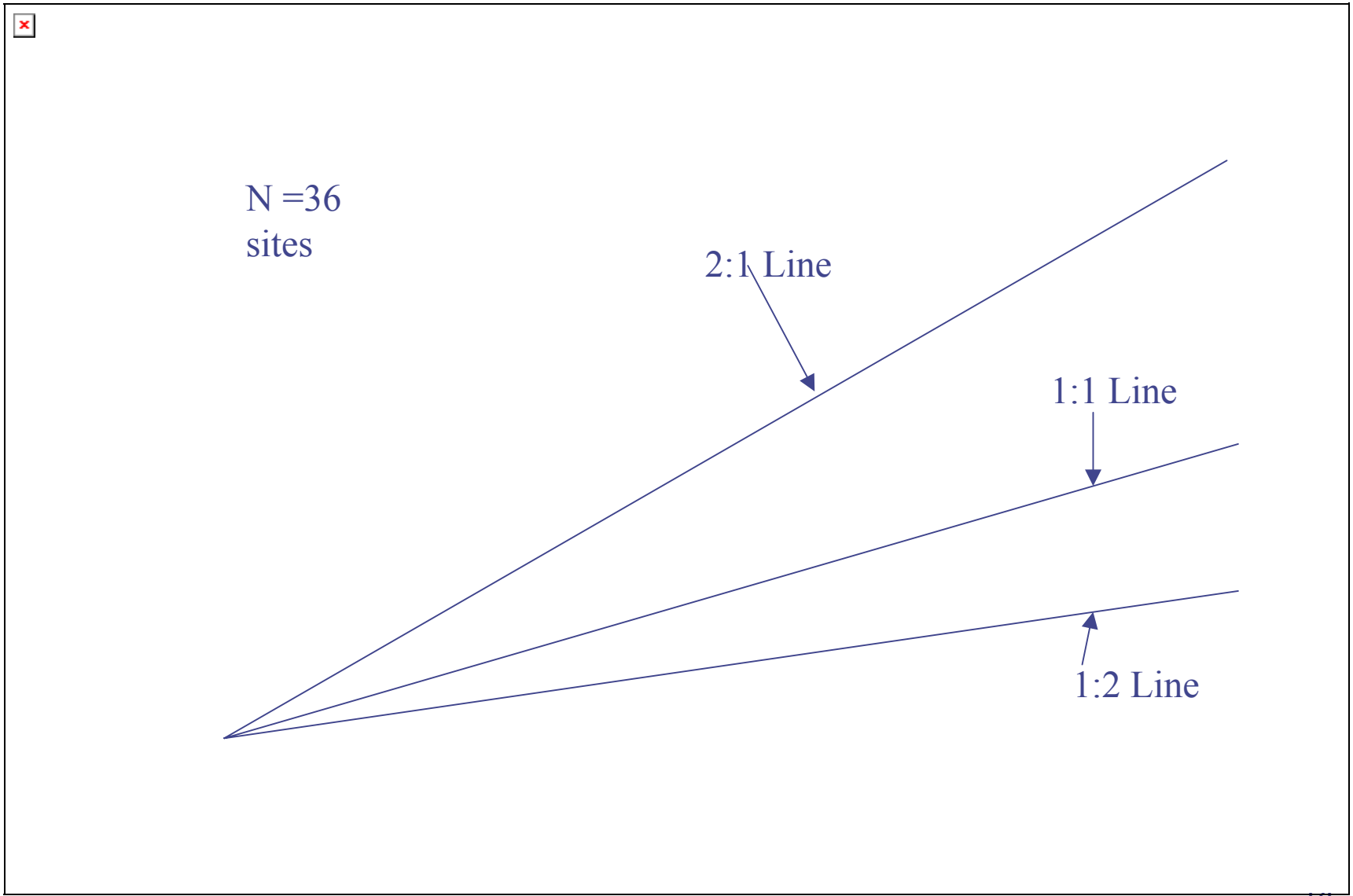
ASPEN vs. Monitoring Data



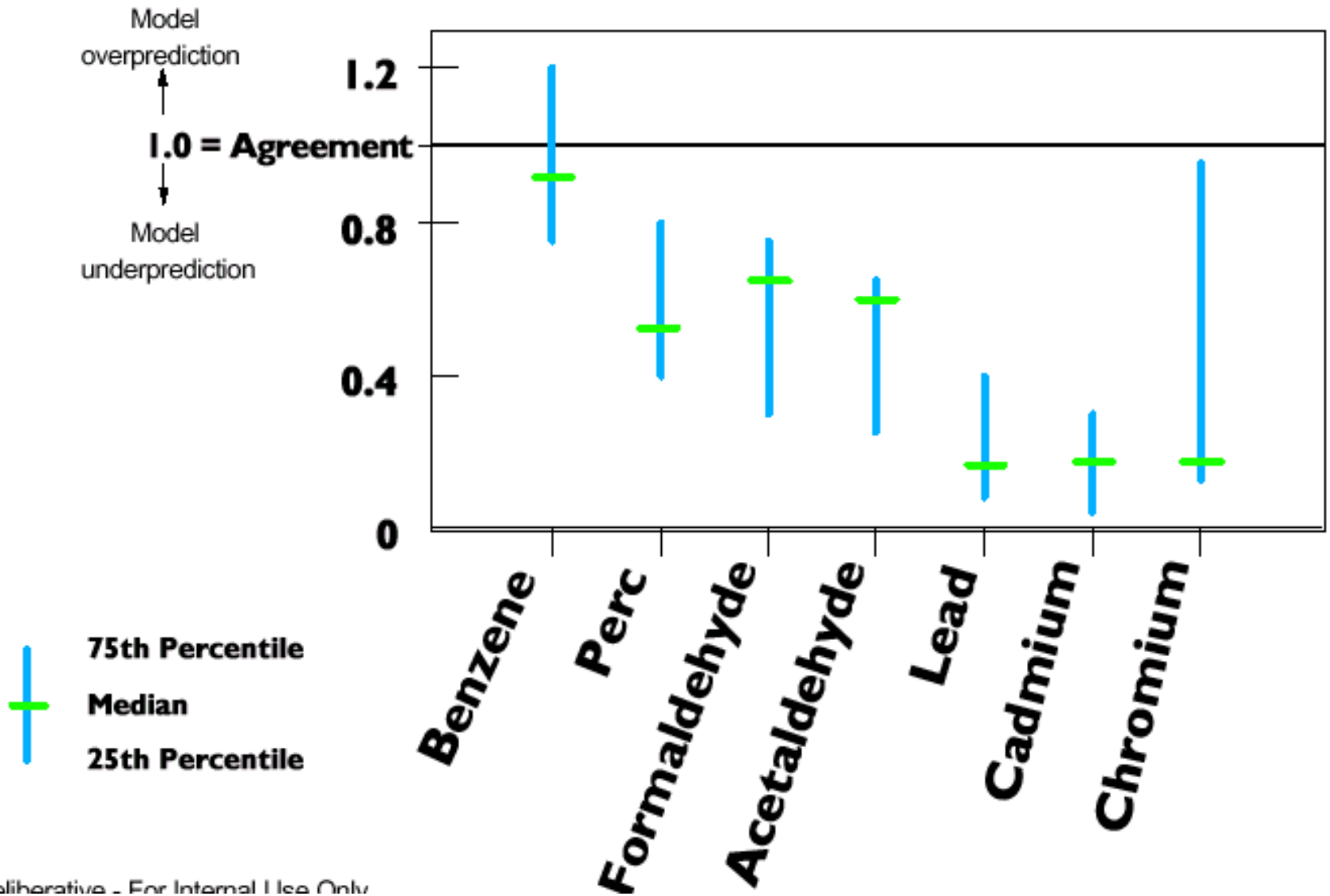
ASPEN vs. Monitoring Data



ASPEN vs. Monitoring Data



NATA Model to Monitor Comparisons



HAPEM4 Modeling Approach:

- HAPEM4 is used to predict your breathing level concentration - follows you around in time and space
- Model builds a series of annual activity patterns for each cohort (a representative person – age and gender) (10) from time activity diary data (CHAD) (considers day of week & season)
- Model tracks cohort movement through time (over a year) and space (through microenvironments (37) located within census tracts) and determines a composite breathing level concentration for the time period.

HAPEM4 Modeling Approach (continued)

- Microenvironment concentration are determined as a function of ambient concentration and indoor source term (ME Factors)

  [ME] = [AMBIENT]*F + [INDOOR]

  Ambient from ASPEN

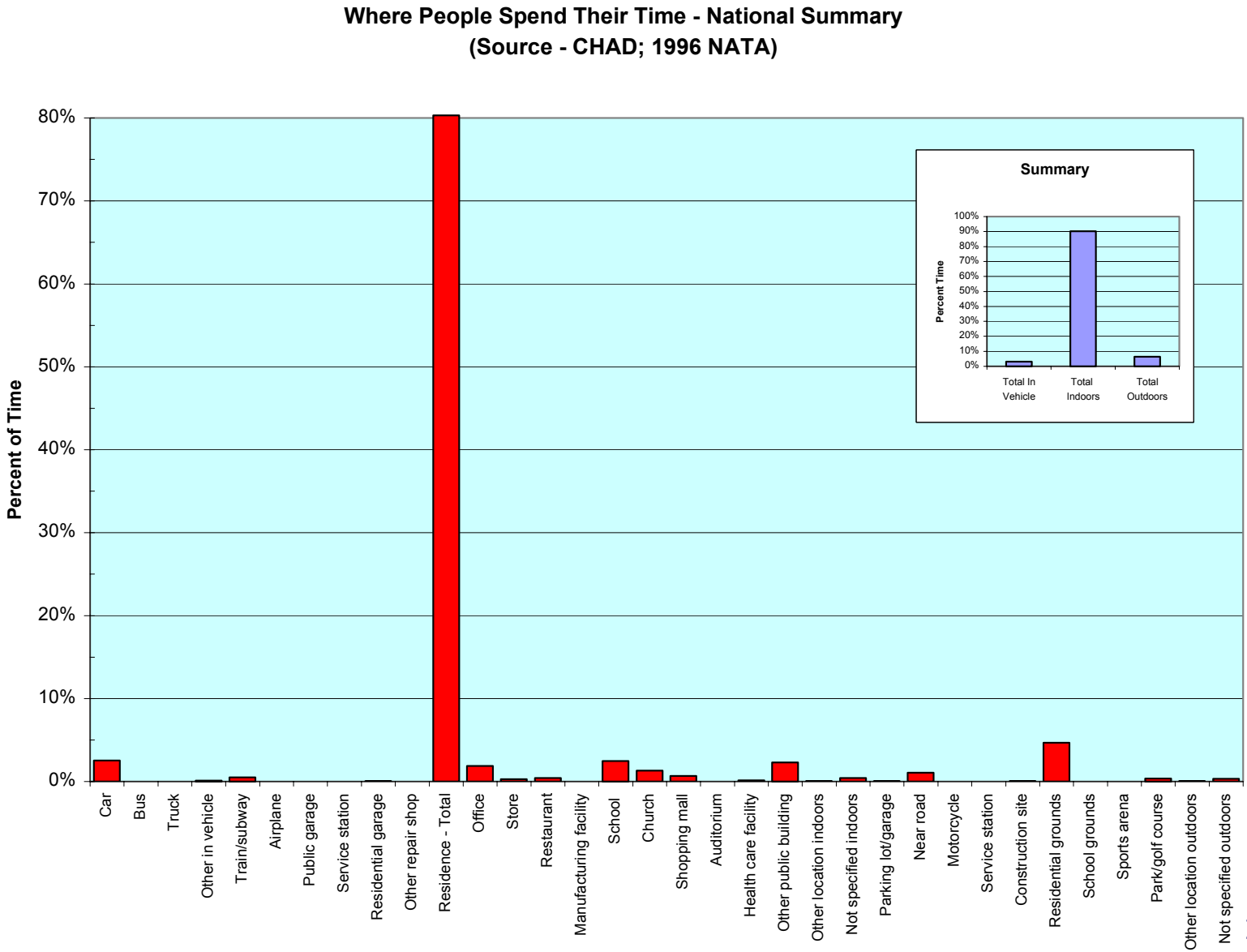
  F = Penetration Factor * Proximity Factor

- Population exposures are determined by prorating cohort exposure by the appropriate population in each census tract (1990 Census; 61,258 Tracts)

Strengths of HAPEM4

- Incorporates inhalation exposure route
- Determines indoor exposures from outside sources
- "People don't live outside at census tract centroids"
- Apply demographic distributions to exposures
- Allows for commuting between tracts - important when local tracts to tract variations are large
- Framework is in place for future improvements to exposure assessment

Why indoor air component is so important



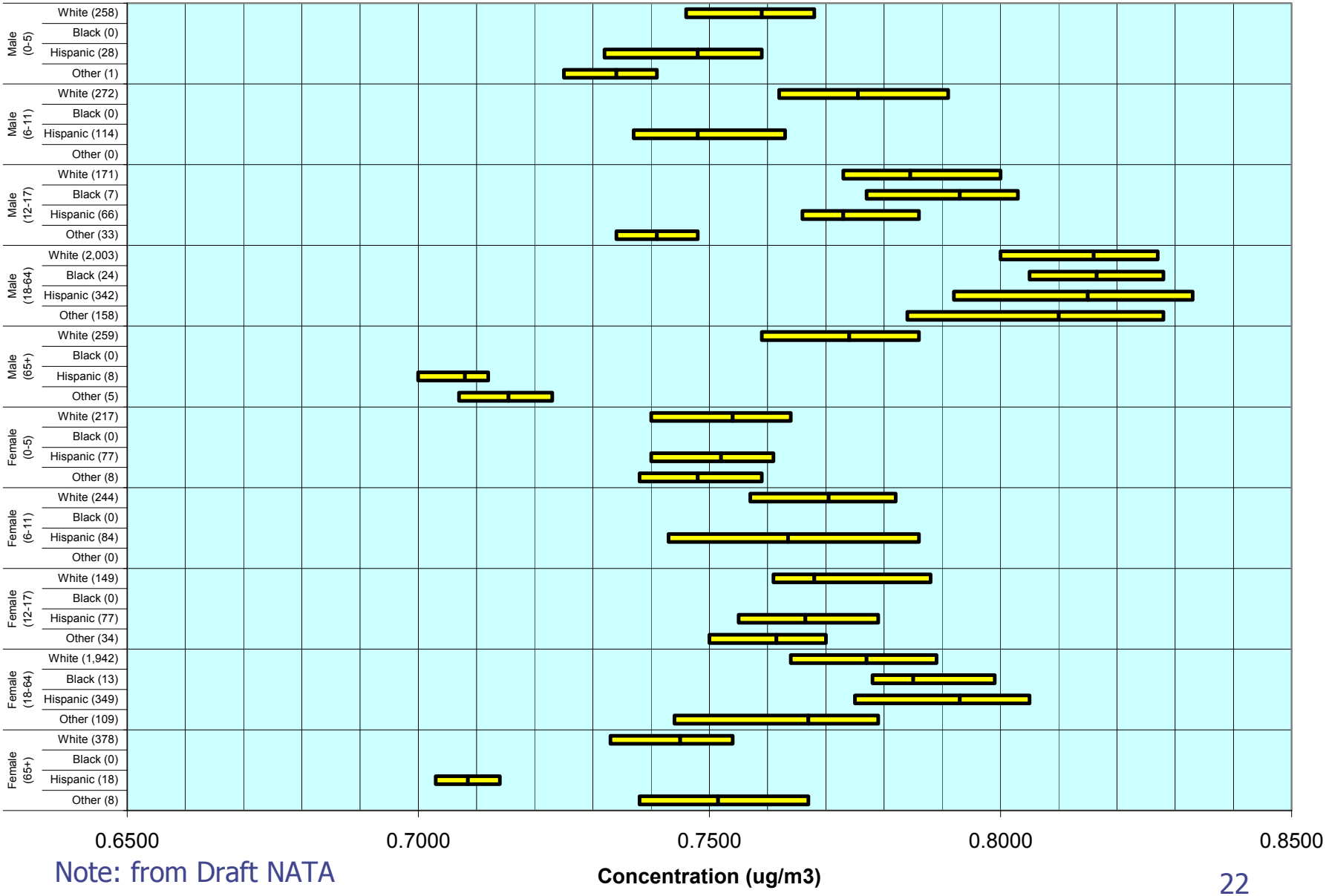
Limitations of HAPEM4

- Not suited for prediction of "extremes" in distribution of exposures
  - Model does not allow for a concentration gradient within a tract
  - Limited studies to develop ME factors for most HAPs
  - ME factors are in model as "best" estimate not ranges
  - No spatial or temporal variability in ME factors
  - Annual Activity patterns built from a few single day diary entries.
  - Daily temporal sequence of activities not retained
  - Activity patterns data for certain demographic groups is limited
- Model has not yet been fully evaluated against personal monitoring data
- Indoor sources data not available for many MEs

HAPEM4 Model Findings from the Initial National Scale Assessment

- HAPEM4 predicted exposure concentrations generally lower than ASPEN ambient predictions (from NATA)
  - Overall Average – about 80% of ambient
  - Particulate HAPs - 75% of ambient
  - Gaseous HAPs - 81% of ambient
  - Onroad Mobile Gaseous HAPs - 101% of ambient (proximity term)
- Best Suited for predicting "population" exposures
- Exposures highly dependent on "indoor - residence" ME factor
  - Most cohorts spend average of 15+ hours indoors

Benzene Exposure Concentration Distribution Among Cohorts in an Urban CA Census Tract

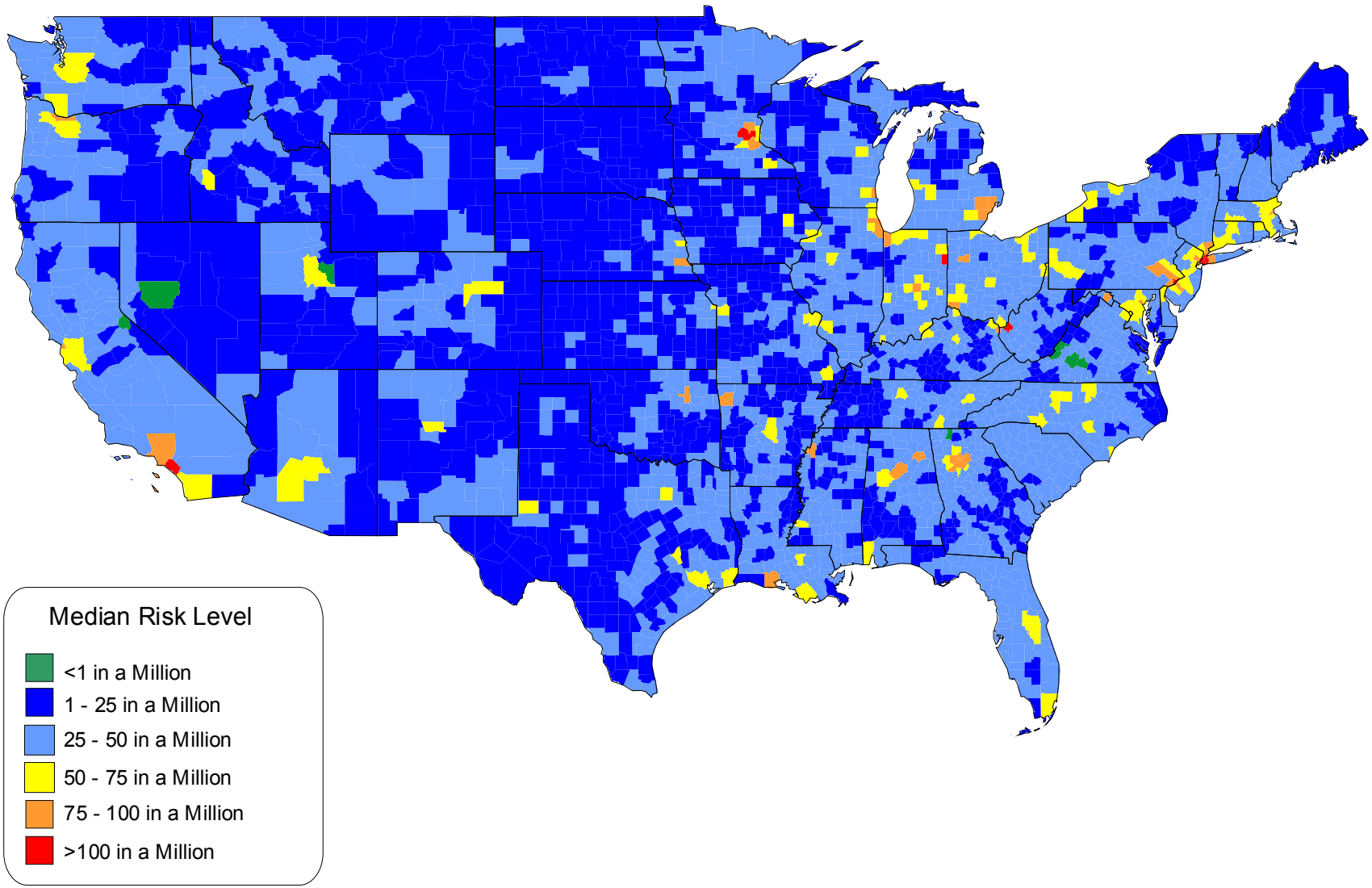


Note: from Draft NATA

Risk Characterization

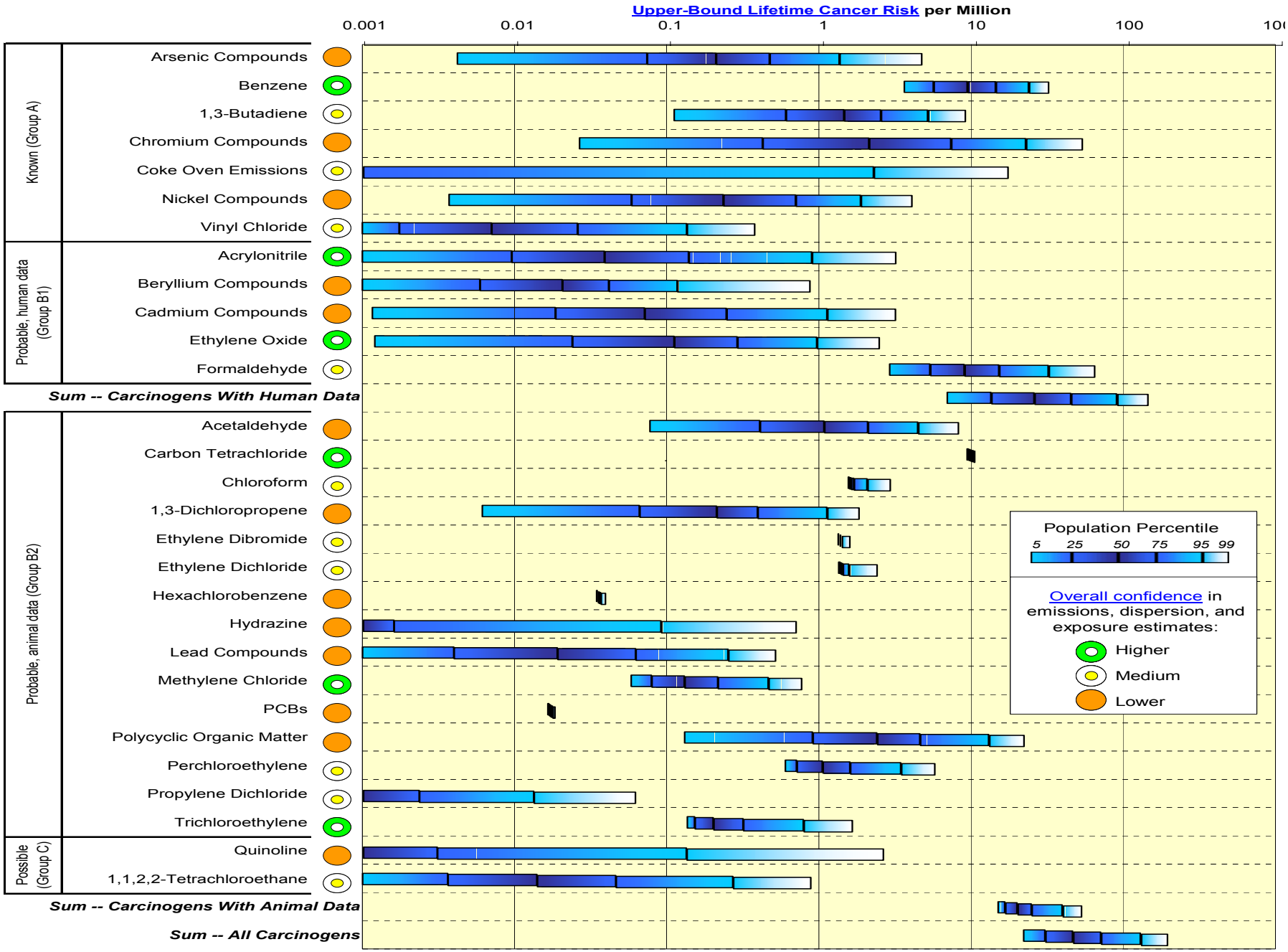
- Cancer
  - URE = risk per ug/m3, for lifetime
  - Risk = URE for each substance x median exposure for each tract
  - Result: ca. 61K risk estimates x 29 substances
- Non-cancer
  - RfC = level believed safe
  - HQ = median exposure for each tract / RfC
    - Ratio between "safe" level and exposure
  - Result: ca. 61K HQs x 27 substances

NATA - National Scale Assessment
Predicted County Level Carcinogenic Risk



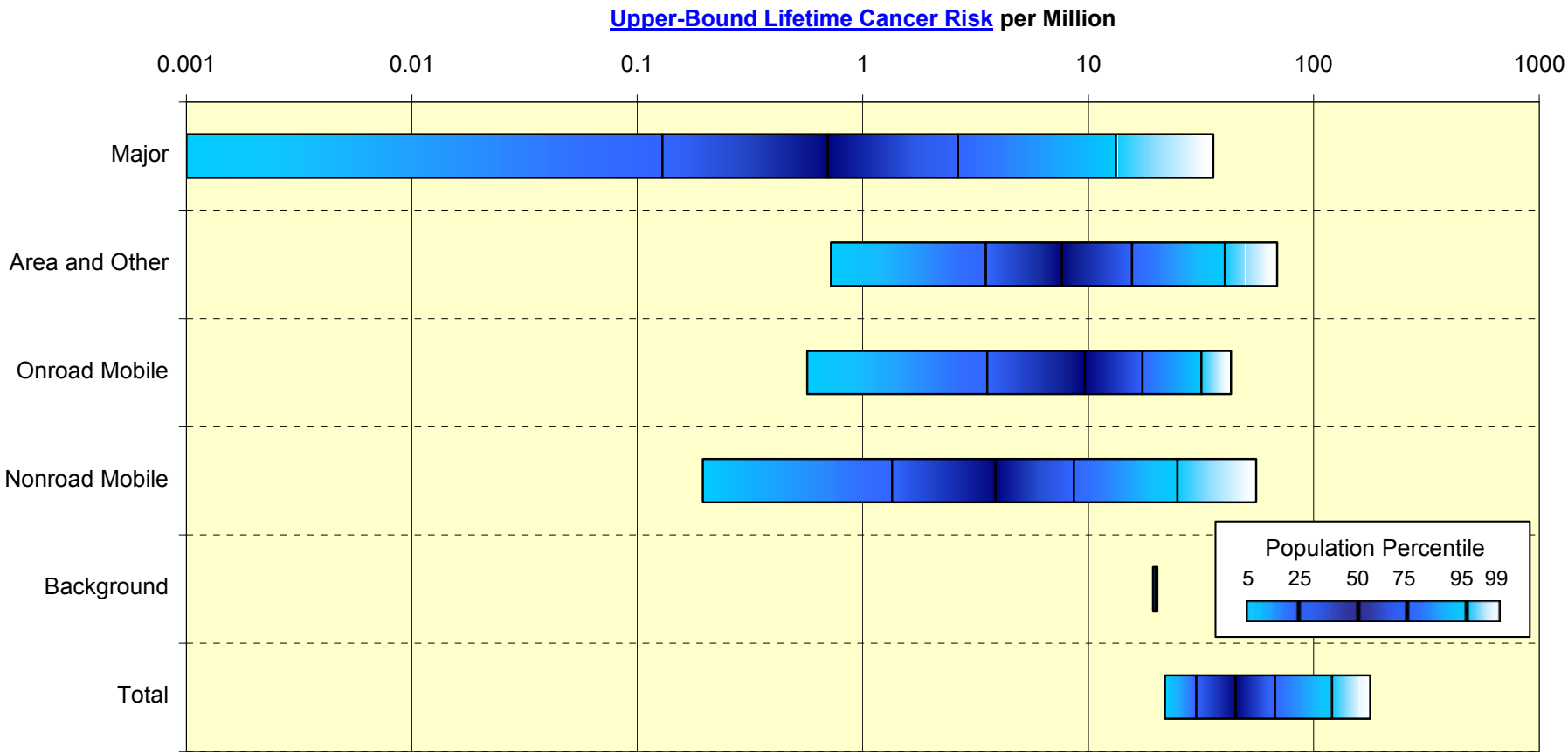
1996 Risk Characterization

Distribution of lifetime cancer risk for the US population, based on 1996 exposure* to all sources combined.



1996 Risk Characterization

Distribution of lifetime cancer risk for the US population, based on 1996* exposure to 29 carcinogenic air pollutants from various source sectors



** Results are based on inhalation exposure to outdoor sources only. Although these results assume continuous exposure to 1996 levels of air toxics over a lifetime, current and planned control programs are expected to substantially reduce these exposures and associated cancer risk for some pollutants. See additional information on the following page.*

Initial National-Scale Assessment Risk Characterization

- Cancer
  - National drivers[1]
    - Benzene
    - Chromium
    - Formaldehyde
  - Regional drivers[2]
    - Arsenic
    - 1,3-Butadiene
    - Coke oven emissions
    - POM
- Non-Cancer
  - National drivers[3]
    - Acrolein
  - Regional drivers[4]
    - Acetaldehyde
    - Arsenic
    - 1,3-Butadiene
    - Formaldehyde
    - Manganese

[1] Risk > 10 in 1 million to 25 million people
[2] Risk > 10 in 1 million to 1 million people OR Risk > 100 in 1 million to 10,000 people

[3] HQ > 1.0 to 25 million people
[4] HQ > 1.0 to 10,000 people

Initial National-Scale Assessment Risk Characterization

- Cancer
  - National contributors[1]
    - Acetaldehyde
    - Carbon tetrachloride
    - Chloroform
    - Ethylene dibromide
    - Ethylene dichloride
    - Nickel
    - Perchloroethylene

- Cancer

  Regional contributors[2]
    - Acrylonitrile
    - Beryllium
    - Cadmium
    - Ethylene oxide
    - 1,3-Dichloropropene
    - Hydrazine
    - Trichloroethylene
    - Quinoline
    - 1,1,2,2-Tetrachloroethane

[1] Risk > 1 in 1 million to 25 million people
[2] Risk > 1 in 1 million to 1 million people

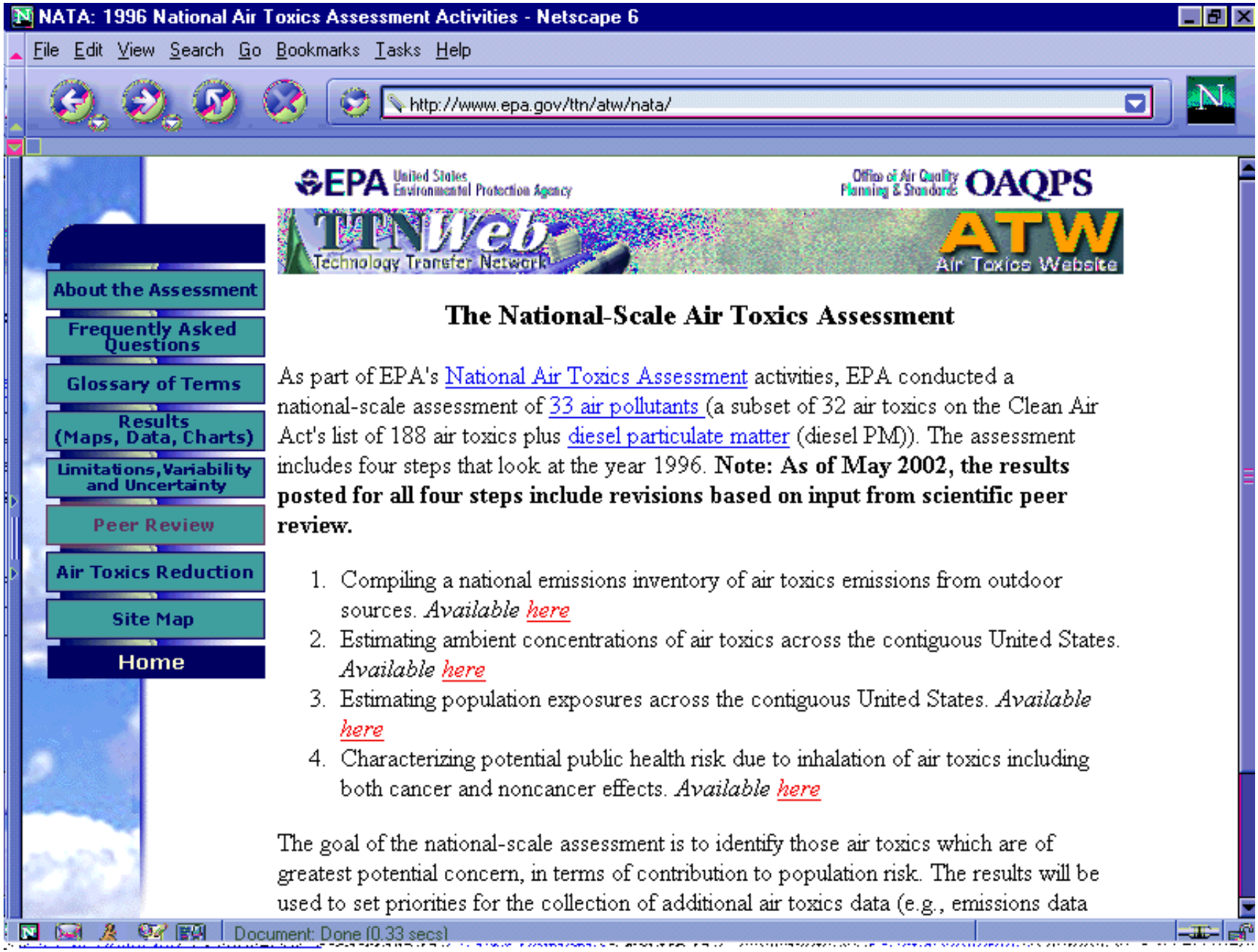
Initial National-Scale Assessment Risk Characterization

- **Not found to be drivers or contributors**
  - Hexachlorobenzene
  - Lead compounds
  - Mercury compounds
  - Methylene chloride
  - PCBs
  - Propylene dichloride
  - Vinyl chloride
- **But this assessment cannot exonerate HAPs because:**
  - It includes inhalation exposure only - some air pollutants (e.g., PCBs, mercury, lead) may pose significant risks by ingestion
  - It has low resolution – may not capture hot spots
  - Limited comparisons show substantial underprediction of ambient levels, especially for metals
  - It does not estimate individual extremes – only typical exposures

Diesel Exhaust

- EPA ORD will shortly finalize Diesel Health Assessment Document
  - CASAC reached closure on document
- Diesel exhaust: likely human carcinogen
  - Presently unable to assign a carcinogenic potency
  - Possible range of upper-bound risk: 10^{-3} to 10^{-5}
    - Above 10^{-4}, diesel exhaust would dominate risk from all HAPs
- Also, diesel PM contributes to PM-2.5 non-cancer concerns

NATA Website



SAB Comments

- Final advisory issued December 20, 2001
- Panel commended the EPA staff on their work, and noted " … this effort represents an important first step towards characterizing the relationships between sources and risks of HAPs…"
- Critical of some areas of assessment
  - Provided most comments as "recommendations" (both short-term and long-term)

Key SAB Recommendations

- Inventory
  - Make corrections to inventory as identified by S/L/T + industry/public (short-term)
  - Promote uniform national reporting protocol and rules (long-term)
- Modeling
  - Improve chemistry and transport in ASPEN (long-term)
  - Improve activity pattern data for HAPEM4 (short-term)
  - Perform a “full-scale analysis” for benzene (short-term)
  - Include multimedia exposures (long-term)
- Dose-response
  - Verify and update dose-response data (short-term)
  - Improve and expand IRIS process (long-term)

Key SAB Recommendations (cont'd)

- Risk Characterization
  - Implement alternative approaches to mixture aggregation (short-term)
  - "Ground-truth" exposure estimates (both short/long-term)
  - Improve presentation of risks for the lay public
- Uncertainty & Variability
  - Color-code outputs to show relative confidence (short-term)
  - Perform a scenario-based assessment for a few HAPs in a limited geographic area
  - Develop more comprehensive approach (long-term)
- Other
  - Separate diesel PM into its own chapter (short-term)
  - Improve coordination of research efforts among EPA offices (long-term)
  - Current study not appropriate for Section 812 benefits assessment

Where do we go from here?

- Detailed Case Study for Houston
  - include indoor air; personnel monitoring; variability
- Publish first in a series of NATA Technical Documents (Late Summer 2002)
- Start 1999 modeling (Summer/Fall 2002)
- Promote use of results to facilitate planning and data gathering activities (ongoing)
- Continue to mine databases to identify patterns and data gaps (ongoing)
- Support urban-scale and local-scale assessments - compare and contrast results (ongoing)
- Future actions will use results of national-scale assessment in conjunction with urban- and local-scale assessments
  - For example, mobile source proposed/final rule in 2003/2004